

- [0235] Alternatively some other information in the sync frame from the foreign cluster is analyzed to determine whether the device moves its operations to the foreign cluster.
- [0236] Otherwise the device continues its operations in the current cluster.
- [0237] Moving Operations to a New Cluster
- [0238] When a NAN device operates in a network of synchronized clusters, it shall do as follows when moving its operations to a new cluster upon detecting the existence of the new cluster through passive discovery:
- [0239] a) If the device is a master device in the current/old cluster, the rules are as follows:
- [0240] The device transmits as a master device in the current/old cluster at least one sync frame that contains information about the new cluster. This includes information at least about TSF value and discovery window schedule of the new cluster.
- [0241] Once the device has transmitted at least one sync frame in the current/old cluster with information about the new cluster, it shall start operating in the new cluster and ceases all the operations in the old cluster.
- [0242] b) If the device is a non-master device in the current/old cluster, the rules are as follows:
- [0243] The device shall start operating in the new cluster and ceases all the operations in the old cluster.
- [0244] When a NAN device operates in a network of isolated clusters, it shall do as follows when moving its operations to a new cluster:
- [0245] a) Regardless of whether the device is a master or a non-master device in the current/old cluster, the device shall start operating in the new cluster and ceases all the operations in the old cluster.
- [0246] Aligning Discovery Window Schedules
- [0247] When a NAN device operates in a network of synchronized clusters, it shall do as follows upon detecting the existence of the new cluster from a received sync frame that contains information about the new cluster and the new cluster is indicated to be the one whose discovery window is to be used:
- [0248] a) If the device is a master device in the current/old cluster, the rules are as follows:
- [0249] The device may transmit as a master device in the current/old cluster at least one sync frame that contains information about the new cluster.
- [0250] The device starts using the discovery window schedule of the new cluster.
- [0251] The device may activate passive discovery to find out whether it can detect the new cluster and whether it can receive sync frames from the new cluster with high enough signal level in order to synchronize from perspective of sync frame transmissions.
- [0252] b) If the device is a non-master device in the current/old cluster, the rules are as follows:
- [0253] The device starts using the discovery window schedule of the new cluster.
- [0254] The device may activate passive discovery to find out whether it can detect the new cluster and whether it can receive sync frames from the new cluster with high enough signal level in order to synchronize from perspective of sync frame transmissions.
- [0255] D. Privacy Protection for Increasing Service Anonymity
- [0256] In accordance with an example embodiment, the invention may be used in the logical architecture of Neighbor Awareness Networking (NAN), to increase privacy of users and services running in a synchronized NAN cluster.
- [0257] In accordance with an example embodiment, the invention scrambles the Service Name before it is loaded as the scrambled Service ID into in a subscribe or a publish service discovery frame.
- [0258] The Service Name is sequentially scrambled with numerical values or components of an array of components (A1, A2, . . . Ak) provided by the applications running in the subscribing device and in the publishing device.
- [0259] The applications running in the subscribing device and the publishing device also provide a time interval value "I", which is the duration between the selections of sequential components of the array.
- [0260] In both the subscribing device and in the publishing device, the respective applications provide the array (A1, A2, . . . Ak) and the time interval value "I", to the NAN stack comprising the NAN Discovery Engine and the MAC layer in the respective devices. The publish device and the subscribing device have similar applications that provide all the same information (array, time interval value, service name) to the NAN stacks in the respective devices.
- [0261] In the NAN stack in both devices, a hash argument is assembled for each time interval "I", using one of the sequential components of the array, the synchronized timestamp Tm of the NAN cluster. The hash argument is operated on by a hashing algorithm, such as the SHA-256 Secure Hash Algorithm. The 48 lowest bits of the SHA-256 algorithm may be used as the scrambled Service ID.
- [0262] The resulting expression for the scrambled Service ID for each time interval "I", may be
- $$\text{Service ID} = \text{SHA-256}[48](\text{Service Name}, A_j, T_m),$$
- [0263] where A_j is the j th numerical value or component of the array (A1, A2, . . . Ak)
- [0264] and Tm is the synchronized timestamp Tm of the NAN cluster.
- [0265] When the subscribing device transmits the subscribe message as a NAN service discovery frame to the publishing device, it loads the service ID field with the scrambled Service
- [0266] ID.
- [0267] The publish device operates in parallel with the subscribing device, to compute a hash argument for each time interval "I", using one of the sequential components of the array, the synchronized timestamp Tm of the NAN cluster. The hash argument is operated on by the SHA-256 algorithm to output a scrambled Service ID for each time interval "I".
- [0268] The publish device performs operations similar to the subscribe device to determine Service ID of the published service considering the array, the time interval and the service name.
- [0269] The publish device may be frequently receiving a variety of wireless message types in an active cluster. When the publish device receives any subscribe message during a discovery window, it takes the contents of the received Subscribe ID field and does a comparison.
- [0270] The publish device takes its own Service Name, the current time Tm, and the component Ai in the array (A1, A2, . . . Ai, . . . etc.), corresponding to the current time Tm and